GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | , PG_00056135 | | |
| Field of study | Mechatronics | | |
| Date of commencement of studies | October 2022 | Academic year of realisation of subject | 2024/2025 |
| Education level | first-cycle studies | Subject group | |
| Mode of study | Full-time studies | Mode of delivery | at the university |
| Year of study | 3 | Language of instruction | Polish |
| Semester of study | 6 | ECTS credits | 2.0 |
| Learning profile | general academic profile | Assessment form | assessment |
| Conducting unit | Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | dr hab. inż. Szymon Grymek | |
| | Teachers | | |

**Lesson types and methods of instruction**

| Lesson type | Lecture | Tutorial | Laboratory | Project | Seminar | SUM |
|---|---|---|---|---|---|---|
| Number of study hours | 15.0 | 0.0 | 15.0 | 0.0 | 0.0 | 30 |

E-learning hours included: 0.0

**Learning activity and number of study hours**

| Learning activity | Participation in didactic classes included in study plan | Participation in consultation hours | Self-study | SUM |
|---|---|---|---|---|
| Number of study hours | 30 | 0.0 | 0.0 | 30 |

**Subject objectives**

Understanding the basics of optimization and polyoptimization as applied to design and control in robotics.

**Learning outcomes**

| Course outcome | Subject outcome | Method of verification |
|---|---|---|
| [K6_W10] has a basic knowledge about development trends in terms of engineering and technical sciences and scientific disciplines: Mechanical Engineering, Automation, Electronics and Electrical Engineering, adequate for Mechatronics curse | Student knows the ways of using artificial intelligence methods in optimization. | [SW1] Assessment of factual knowledge |
| [K6_U06] is able to identify and formulate specification of simple, practical engineering tasks, distinctive for mechatronics | Student is able to define a robotics-specific optimization task. | [SU1] Assessment of task fulfilment |
| [K6_W08] knows and understands design and production processes of elements and simple mechatronic devices | Student knows the methods of applying optimization in the design of mechatronic devices. | [SW1] Assessment of factual knowledge |
| [K6_U05] is able to use properly choosen tools to compare design solutions of elements and mechatronics systems according to given application and economic crtierions (e.g. power demand, speed, costs) | Student is able to choose the methods and means necessary for the effective solution of the given optimization task. | [SU4] Assessment of ability to use methods and tools<br>[SU1] Assessment of task fulfilment |
| [K6_W11] has a basic knowledge about the life cycle of mechatronic systems and objects | Student knows the evaluation criteria used in the design of mechatronic systems. | [SW1] Assessment of factual knowledge |

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| Subject contents | LECTURE<br>Optimization and selection. Criteria and decision variables. Polyoptimization. Criteria weights. Utility function. Objective function. Inequality, equality and cube constraints. Linear and nonlinear programming. Gradient and non-gradient methods of minimizing the objective function. Artificial neural networks in optimization. Evolutionary algorithms in optimization.<br><br>LABORATORY<br>Demonstration of defining and solving the selection task.<br>Demonstration of the definition and solution of the poly-optimization task.<br>Demonstration of the use of artificial neural networks in optimization.<br>Demonstration of the use of an evolutionary algorithm in optimization.<br>Student independently defines and solves the task of poly-optimization. |
| Prerequisites and co-requisites | Basics of matrix and differential calculus.Fundamentals of mechanics, robotics, automation, strength of materials and thermodynamics.Basic knowledge of Matlab / Octave / Scilab. |

**Assessment methods and criteria**

| Subject passing criteria | Passing threshold | Percentage of the final grade |
|---|---|---|
| Colloquium | 50.0% | 60.0% |
| Task of poly-optimization | 50.0% | 40.0% |

**Recommended reading**

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| Basic literature | Tarnowski W.: optymalizacja i polioptymalizacja w mechatronice. Wydawnictwo Uczelniane Politechniki Koszalińskiej, 2009<br>Findeisen W., Szymanowski J., Wierzbicki A.: Teoria i metody obliczeniowe optymalizacji. PWN Warszawa 1972<br>Hertz J., Krogh A., Palmer R.G.: Wstęp do obliczeń neuronowych. WNT Warszawa 1993<br>Goldberg D.E.: Algorytmy genetyczne i ich zastosowania. |
| Supplementary literature | Osiński Z., Wróbel j.: Teoria konstrukcji maszyn. Seria PKM. PWN Warszawa 1992Tarnowski W.: Podstawy projektowania technicznego. WNT Warszawa 1997Milkiewicz F.: Podstawy optymalizacji. Skrypt PG. Gdańsk 1995Fortuna Z., Macukow B., Wąsowski J.: Metody numeryczne. WNT Warszawa 1982 Pająk E., Wieczorowski K.: Podstawy optymalizacji operacji technologicznych w przykładach. PWN Warszawa 1982 |
| eResources addresses | Adresy na platformie eNauczanie: |

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| Example issues/ example questions/ tasks being completed | Find the fastest route from point A to point B through 3 centers of different traffic resistance.Determine the design features of a bending spring minimizing material consumption. |
| Work placement | Not applicable |